Natech disasters risk management in France

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Abstract : France is subjected to several types of natural phenomena (floods, earthquake, landslides, storms, forest fires...) and to attacks potentially generated by human activities (industrial facilities, nuclear power plants, transportation of dangerous goods...). The natural and technological risks are managed in France, as regards prevention, protection, intervention, in order to limit their human and economic consequences. Furthermore, an industrial accident could be triggered by a natural event. This paper explains how France is prepared to face this kind of disaster (called "natech disaster"). The description of the French approach is illustrated by the feedback of two recent major events (storm in December 1999, flood in South of France in September 2002).

Keywords :Natech disasters, natural risk prevention policy, natural risk prevention plans, industrial risk prevention policy, safety report

1. INTRODUCTION

In France, a policy for major risks, like natural and technological risks, was developed in order to prevent these risks, and to limit their human and economic consequences.
France is indeed subjected to several types of natural phenomena, such as floods, landslides, earthquakes, avalanches, storms, forest fires, to which can be added volcanoes eruption and cyclones in overseas departments and territories.
On the other hand, human activities create various technological risks, associated with industrial facilities, nuclear power plants, dams, transportation of dangerous goods…

Recent events show that, when a natural hazard strikes, hazardous industrial installations are always at risk and can potentially cause severe damage to the environment and to the population, with knock-on effects that propagate in time and space. There is a need to consider these natech disasters (a technological disaster triggered by any type of natural disaster).

For the two major risks, natural and technological risks, the policies of prevention, the risk management, the actors… are relatively different in France. And it doesn't exist a specific management system for natech disaster. Nevertheless the natech disasters are taken into account, because connections between the two approaches can be made, as it is explained thereafter.

2. NATECH DISASTERS RISK MANAGEMENT

2.1. Natural risk management

Natural hazards can cause severe damage to the population and to the environment and to the population.

In France, the main orientations of the natural risk prevention policy are :

- to better know the natural events and their effects,
- to ensure a monitoring of the natural phenomena, and give the alert when necessary,
- to sensitize and inform the population on the risks and the protection measures,
- to take natural risks into account in the regulation and land-use planning,
- to make prevention works, and adapt existing and future buildings or installations to the natural phenomena,
- to be prepared for crisis situations,
- to deal with the compensation and reconstruction,
- to set up the experience feedback, in order to learn lessons from the exceptional natural events.

Natural Risk Prevention Plans (RPP), which were created by the law of 02/02/1995 (article L.562-1 of the Environment Code), constitute today one of the essential instruments of the actions of the State as regards prevention of the natural risks.

RPPs are the responsibility of the State. They are worked out by the Regional Departments of Environment (DIREN), the District Infrastructure Departments (DDE), the District Departments for Agriculture an Forests (DDAF)...After consultation for opinion of the citizens and local communities, the RPPs are then approved by the Prefet, which represents the government in the Department. The RPPs are annexed to the land-use planning (PLU) of the municipalities.

Drawn-up on the basis of present knowledge of risks, the RPPs help to direct development and to define prevention, protection and safeguard measures for occupied vulnerable areas.

The development of a RPP results in 4 principal phases :

- an informative phase, where a collection of information (archives about historical events, interviews, on site observations...) on the studied natural phenomenon is made,
- the realization of a hazards map, based on a qualitative approach, which classifies the natural hazards in several levels (strong, medium, low, negligible) by considering the nature of the natural phenomenon, the probability of the event and its intensity,
- a assessment of the stakes, which results mainly from the superposition of the natural hazards map with the existent and/or projected occupied areas,
- the construction of a lawful zoning map, and the definition of rules applicable to each of the different zones (prohibitions and restrictions for the new installations,

prevention, protection and safeguard general measures, special measures for existing installations).

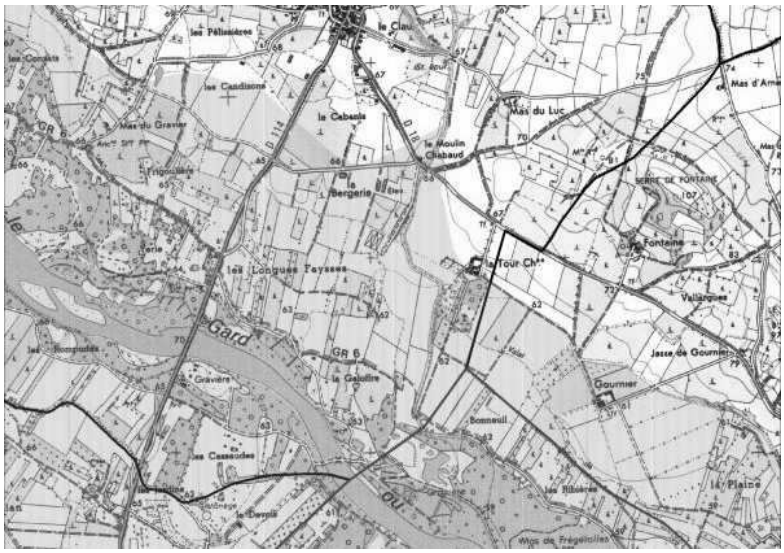

Figure 1 : Example of an flooded zones atlas

Ultimately a RPP can prohibit or subject to regulations all the constructions, including farms, industrial, forest, craft and commercial installations. It is an interesting way to limit the consequences of an natural phenomenon, and thus to avoid natech disasters.

Emergency plans are prepared by the Prefet of each department, in contact with authorities, services and organisations capable of taking the safeguard measures, and whose means are likely to be implemented to face the natural disasters.

2.2. Industrial risk management

The legislation relating to the classified installations for the environment protection (ICPE) is the base of industrial risks prevention policy in France. Apart from the nuclear installations and mines, which are covered by others regulations, the ICPE regulations concern all the industrial activities, the intensive breeding and the waste treatment installations.
The industrial installations are classified according to the properties of the handled substances or according to their activities. The table below shows the various classes :

According the substances (serial 1000)	According the activities (serial 2000)
• 1.1 : Toxic • 1.2 : Oxidisers • 1.3 : Explosives • 1.4 : Flammables • 1.5 : Combustibles • 1.6 : Corrosives • 1.7 : Radioactive	• 2.1 : Agriculture ands animals • 2.2 : Food industry • 2.3 : Textiles, leather • 2.4 : Wood, paper, pulp • 2.5 : Materials, mining products • 2.6 : Chemistry, rubber • 2.7 : Waste • 2.8 : Miscellaneous

Table 1 : Classification of industrial installations (Nomencalture)

And according to its importance, the industrial establishment is said to be :

- in declaration,
- in authorisation (installations not covered by Seveso II, or covered by Seveso II lower tier),
- in authorisation with compensation (installations covered by Seveso II upper tier).

For the two last status, the industrial establishment need a permit to produce. The nuisances generated by the plant (chronic and accidental risks) have to be studied.
The chronic pollution (water, air, ground, noise…) are identified in an impact study report, and the accidental situations (fires, explosion, dispersion of a toxic cloud, environmental pollution) in a safety report.

The objectives of the safety report are :

- to identify and analyse the risks, whether their root causes are internal or external (natural phenomena, for instance),
- to assess the gravity of the major accidents identified, in terms of consequences lengths (safety distances),
- to justify the safety barriers which enable to reduce the level of risk of the studied installations,
- to supply information to enable internal (POI) and external (PPI) plans to be drawn up in order to take the necessary measures in the event of a major accident,
- to contribute to inform the staff and the potentially affected population,
- to provide sufficient information to the authorities to enable decisions to be made in terms of siting of new activities or developments around existing establishments (land-use planning).

The regulation (especially the decree n°77-1133 of September 21, 1977, and the circular of May 10, 2000) indicate that external attacks, therefore the natural risks, must be treated in the safety report. However it's important to underline that these texts do not propose practical method, but only very general instructions.
And only the lightning risk and the seismic risk are governed by particular lawful texts intended specifically for the ICPE.

The new law n°2003-699 of 30/07/2003, relating to the prevention of the technological and natural risks and to the compensation for the damages, requires that prevention plans have to be carried out for technological risks, like it is already made for the natural risks.

3. LESSONS LEARNT

The accidentology provided by the BARPI (one Department of the Ministry of Environment) shows that industrial facilities are vulnerable towards the natural risks (earthquake, floods, storm…), and that they can suffer more or less important damage, being able to lead to a major accident.

This paragraph presents 2 examples of natural events, that have occurred in France and triggered technological incidents or accidents.

3.1. The storms on December 1999 in France

3.1.1 Date, location and description of the natural event

Two strongly storms crossed the country in December 1999 :

- storm 1 : 26 December 1999, at about 02.00, northern half of France (tip of Brittany, Normandy, Ile de France, Champagne Ardennes, Lorraine, Alsace),
- storm 2 : 27 and 28 December 1999, at about 16.00, southern half of France, in particular, the western and central parts (southern Brittany, the Atlantic coast, all areas to the south of a line from La Rochelle to Mâcon, including the Mediterranean coast, and Corsica).

Figure 2 : Broken or uprooted trees in a forest in France

The conjunction of the tide and violent winds (storm 2) had as a consequence the flood of many industrial establishments, especially in the Gironde estuary, in the north-west of Bordeaux.

3.1.2 Damage observed on the industrial facilities

The observed damage on the industrial facilities were as follows :

- Flood in a hydrocarbon deposit in Ambès
  - Damaged electric installations (electrical equipment boxes, pumps, gas-detectors)
  - Basin of storm that was submerged
  - Drainage pipes that were saturated and blocked
  - The deposit's exploitation is suspended during 7 days
  - The hydrocarbon separators were submerged, but had been cleaned 3 days before, therefore there was no pollution of the environment

- Flood in a hydrocarbon deposit in Bayon-sur-Gironde
  - Damaged pumping station of the water network, used to fight against fire
  - No more supply electricity

- The electric stations (high and low tension), the wharf, the boiler room, the retention dikes, the pumping stations (except the pumps of fertilizers), the offices didn't suffer from water
- No environmental impact

- Flood of the thermic power station in Ambès
  - Flooded administrative and productive buildings, staff canteen, system intended to pump cooling waters
  - Cellars flooded by sewers
  - A part of the pipes pits is drowned
  - The recovery tank of the drops overflowed, but the retention dike however functioned well
  - The hydrocarbon separators were submerged, product was spread in the environment

- Flood in a alcohol production factory, in Ambès
  - Tanks of H_2SO_4, HCl and NaOH, located in basement, were spilled and emptied in the retention. Thus the products should have been pumped.
  - Loss of the processing system and the paper documents
  - No electricity on the industrial site during 3 days

- Flood in a manufacturing plant of fertilizers, in Ambès
  - The cuts of electricity threatened the cooling system of the cryogenic storage of ammonia
  - The electricity supply of the plant was stopped during 7 days, the plant functioned for this period thanks to its own cogeneration
  - Damaged loading arm, a empty wagon ran off the line, unusable railway

- Flood in a LPG storage and cylinders filling plant, in Ambès
  - Fences, roofs, the railway and the monitoring system were damaged
  - Damaged electric installations
  - Activities of the plant stopped during 3 days
  - No electricity supply, use of a power generating unit in substitution
  - Cylinders were dispersed all around the establishment (up to 1 km)

- Flood in a plant of carbon black, in Ambès
  - Production stopped during 8 days
  - Significant damage (two power generating units, electric equipments, pumps)
  - 300 tons of stored products were soiled by the flood
  - Damaged railway
  - No notable pollution of natural environment

- Flood in a manufacturing plant of sodium chlorate in Ambès
  - The roof of a salt storage hangar and that of a building sheltering electric room flew away
  - Flooding of the pumping station (electric and diesel pumps) of the water network, used to fight against fire
  - No more electricity, the installations were set in safety

- Destruction of 10 km of railway
- The basins of water treatment and fire waters were drowned. Water containing NaCl flowed in the Dordogne, without notable impact.

- Food in surfaces treatment plant, in Muret
  - Short-circuit, fire in a buiding
  - The rain water supply network was blocked, no environmental impact

- Flood in the nuclear power plant, in Blayais
  - Loss of the sources of auxiliary power supply (225 kV) on all the sections of the power station, and loss of electrical supply network 400 kV on sections 2 and 4
  - Damaged protection dam of the platform
  - 30 cm of water in the North-Western part of the power station
  - Flooded buildings : buildings containing the pumps of the rescued circuit of raw water, technical galleries, some buildings containing the electrical departures, bottom of the building containing combustible o sections 1 and 2
  - The flood damaged essential systems for safety

3.1.3 Significant lessons learnt

The significant lessons learnt from this event are as follows :

- Authorities and industrialists became aware of the danger presented by a flood in this sector, where many dangerous factories are established.
- The DRIRE inspectors, who control usually the dangerous installations, asked the industrialists to change the safety report of their factory, by considering the scenario of flood.
- The development of a flood risk prevention plan began following this event.
- Industrialists took certain measures : to heighten installations presenting a risk in contact with water, to improve the circulation of water, to fix the cylinders, to build a wall around the room containing the equipment to fight against the fire…
- In the case of the power station in Blayais, an action plan aiming at reinforcing protection against the flood was carried out just after the event (dam of protection, alarm system, watertight partitions or systems…). Moreover one re-examination of all the French nuclear power station was made : checking of all the devices and procedures existing against the flood risk, re-examination of the design criteria relating to the flood risk.

3.2. Floods in Southern France in September 2002

3.2.1 Date, location and description of the event

It rained intensively in the South of France on 8th and 9th September 2003. A large geographical sector was concerned (approximately 6000 km^2), gathering the department of Gard, the east of Hérault and the west of Vaucluse.

Figures 3 and 4 : Flood in the South of France (September 2002)

3.2.2 Consequences observed on the industrial facilities

The industrial facilities (laundry, chemical and pharmaceutical industry, wine cellars…) were affected by floods. The companies were more or less affected (property damages, financial losses…), depending on their geographical location.

The photographs below shows examples of observed consequences :

Figure 5 : Flood in a wine cellar

Figure 6 : A domestic LPG tank

In fact, there was no major accident caused by the flood, but several incidents which could have led to a major accident.

The only environmental impacts were :

- Increase in the turbidity of water,
- Spreading of a lagoon by low wall breaking,
- 2 tanks containing respectively bleach and acetic acid were spilled (small quantities).

It was noted that :

- for the crisis management, the authorities gave the priority to the rescue of populations,
- no particular alert was addressed by the authorities to the dangerous industrial facilities,

- the DRIRE inspectors, who control usually the dangerous installations, had difficulties contacting the facilities during the days after the flood, in order to know if incidents had occurred,
- the majority of the companies are not informed of the existence or not of a flood risk prevention plan on their municipalities,
- some rare arrangements had been taken before September 2001, in particular on industrial sites which had already been flooded : work, construction of the offices, the machines, the electric equipments and storage of dangerous products, in areas not reached by the flood,
- generally, the production was stopped, the installations were set in safety,
- there were network cuts (cuts of gas and electricity, unavailable telephone, plants entrances blocked…),
- after the flood, the industrial installations need to be cleaned and restored.

3.2.3 Significant lessons learnt

Interesting lessons were learnt about this event.

The possible improvements are stated below :

- Necessary alteration works (construction of dams, cleaning of the rivers…)
- Better knowledge of the natural event
- Good functioning of the means of communication and various networks (electricity, gas, water, roads…) during and after the crisis
- Taking into account the consequences of floods on industrial facilities

4. CONCLUSIONS

The Ministry of Environment, with the assistance of INERIS (Institut National de l'Environnement Industriel et des Risques), is reflecting to improve the way of taking into account the natural risks for the dangerous industrial facilities.